

area. Owing to the friction which the wind experiences in passing over the surface of the earth, however, this upward current could exist at its maximum only at a considerable height. But it is important to observe that there may frequently be a considerable amount of current upwards in the regions where birds "hover," at least in the neighbourhood of a cyclonic vortex. But how much lifting force is necessary to sustain, say a gull, in the air? A gull moves its wings in ordinary flight at from 160 to 200 (double) strokes per minute, and reckoning 12 inches as the greatest vertical depth through which the bird can raise itself by one (double) stroke, we find that it possesses the power of raising itself about 180 vertical feet per minute. This, however, is less than one-half of the rate at which we have found the currents to rise near the centre of a cyclonic depression. From this we may judge it is likely enough that birds "hover," or suspend themselves motionless in the air through the influence of upgoing currents, which are masked to our observation by the fresh winds which accompany them.

A kestrel may, however, support itself largely by its peculiar quivering play of the wings, and I think it must be difficult to determine how much support a bird may contribute by such motion, when at a height where it is difficult to observe it.

I have frequently observed gulls "hovering" upon currents of air which were heaped up by the wind striking obliquely upon a rising coast line, in which case the head is turned at an angle to the general direction of the wind, so as to face the heaped-up and rising currents. Such passing over irregular ground are irregular or gusty, and tax the bird's utmost muscular agility to prevent a sudden lateral turning to leeward, in which case the rapid flight with the currents may be compared to the fall of a stone to the ground. The same upward direction to the atmospheric currents must be imparted by the contracting sides of a converging valley. But when such local forces derive aid from the upward currents peculiar to cyclonic winds, atmospheric conditions favourable to "hovering" must, I think, frequently occur.

On the other hand, I cannot conceive it to be possible for birds (and I do not think that the third chapter of the "Reign of Law," gives any sufficient explanation) to sustain themselves motionless on currents of air which are purely horizontal, for in such case there is nothing to compensate—when the wings are slanted at the necessary angle to prevent falling—the backward horizontal force, and the creature must inevitably be driven backwards.

DAVID CUNNINGHAM

Dundee, February 5

ON August 12, 1881, I observed a hawk maintaining an apparently stationary position at a height of about 200 feet above the surface of flat ground. He was *as a matter of course* facing the wind, which blew, if I remember rightly, from the west. For the most part his wings remained motionless, but now and then he fluttered them for a little while. This was over the sensibly level plain which lies between Machrihanish Bay and Campbeltown Loch, at the southern end of the Mull of Cantire, and, curiously enough, on or close to the Duke of Argyll's property. The exact spot was about a mile and a half eastwards from Machrihanish Bay, and about three-quarters of a mile northwards from the southern boundary of the plain. There could not be any "slant upward current," such as Mr. Airy supposes, maintaining him in that position; at any rate, there was no sloping ground near.

I watched this bird for about ten minutes, and he verified in a remarkable manner the views I had held on this subject for many years, namely, that, given a steady wind blowing with a velocity which lies somewhere between certain possibly calculable limits, a hawk can remain for a time apparently motionless above a point; he is, in reality, descending a slightly inclined plane, and requires to recover vertically lost ground by the occasional use of his wings.

WILLIAM GALLOWAY

Cardiff, January 30

In the letters on the above subject that have appeared in some recent numbers of NATURE, the writers lead us to believe that a current of air is *necessary* to enable a bird to "hover" or retain when on wing a motionless position. My observations lead to an opposite conclusion, as I have often seen both hawks and terns remain steadily poised, when there was not a breath of wind. That there was no wind where the birds (*terns*) were, was shown by their heads, when hovering, being turned in different directions, although at only a short distance from each other.

Generally, if not always on these occasions, I noticed that the birds spread out their tails in a more or less depressed position, as if to counteract any forward movement likely to be caused by the wing-motion.

J. RAE

4, Addison Gardens, February 3

IN reading the letters published in your last issues of NATURE with regard to the hovering of birds, it struck me that a very similar thing can be seen sometimes, among inanimate objects when an imperfect attempt is made to cause "ducks and drakes" with a flat stone. I have commonly noticed that the missile curves sharply upwards and for a moment "hovers" as it were, in mid-air before dropping. In this case and also in the similar one of the motion of the boomerang, the slanting upwards and the apparent hovering do not require, and need not be due to, upward currents, but merely depend upon the force of a horizontal current of air meeting the inherent force of the moving body. It is not unreasonable to suppose a similar simple solution of bird hovering.

C. S. MIDDLEMISS

Linnaeus Street, Hull, February 3

Is there not an error in the letter of NATURE (p. 312)? The writer there suggests, as it seems to me, that a bird could maintain a position of rest, with respect to the earth, by a suitable slope of the wings against a horizontal wind. Now, as I pointed out in NATURE, vol. xxiii. p. 78, such lifting action on the part of the wind can only take place in the interval between the time when the bird is first launched from the cliff, and the time when it has by friction attained the velocity of the wind. That this interval is not a long one, is shown when balloons or other objects are launched.

[It may be well to notice, that if there were *no* friction there is no lifting power; so that if we object to the above, that "the bird gives such a *very* small friction with the wind," we thereby do away to the same extent with the lifting power; just as a frictionless ship in a constant stream would be unmoved were it sufficiently tapering.]

From the above considerations I have been compelled, since writing my last letter, to ascribe the hovering power of birds—

1. To the "exquisite muscular sense" by which they can take advantage of all upward currents of air, shifting their positions for this purpose. In an elastic fluid as the air, I imagine that the stream-lines, even over the sea, are far from horizontal. I believe the evidence of balloons over the sea goes to show this.

2. There is, to use a common expression, "flying *and* flying," just as a man can skate without striking out, so can a bird give itself some support by quiet movements of wings and tail.

I may remark that kestrels keep fluttering their wings at short intervals while hovering; they are never still for long. So also terns and gulls, as seen from the fixed point of a cliff, are always moving and shifting in a quiet way, which may disguise both a seeking of upward currents and the quiet sort of "flying."

W. LARDEN

Cheltenham College

Science and Theology

CAN you tell me by what right the authorities of Cooper's Hill Engineering College, who are in want of a Professor of Physics, make it a condition that he should "be a Protestant," and should "attend morning chapel and Sunday services with reasonable regularity, showing in this respect a good example to the students?" The institution is one supported by the State, and is surely bound to respect the principles which underlie the State's dealings with religious matters. The president (or whoever is responsible for these preposterous conditions) may have forgotten this fact; but I cannot believe that the present Government will allow an appointment to be made until all "religious" limitations are cancelled from its conditions. As the memorandum stands at present, it appears little short of insulting to scientific men.

C.

Intelligence in Animals

MR. GRENFELL's letter in NATURE, vol. xxvii. p. 292, reminded me of a statement in vol. iii. p. 308 of Cook's last voyage, where Capt. King refers to the ordinary sagacity of bears, described in a "thousand stories" which he heard in

Kamtschatka. He gives a single instance, which, he says, "the natives speak of as a well-known fact, and that is, the stratagem they (the bears) have recourse to in order to catch the bareins, which are considerably too swift of foot for them. These animals keep together in large herds, and love to browse at the feet of rocks and precipices. The bear hunts them by scent till he comes in sight, when he advances warily, keeping above them, and concealing himself among the rocks as he makes his approaches, till he gets immediately over them, and nigh enough for his purpose. He then begins to push down with his paws pieces of rock among the herd below. This manoeuvre is not followed by any attempt to pursue, until he has maimed one of the flock, upon which a course immediately ensues, that proves successful, or otherwise, according to the hurt the barein receives. I cannot conclude this digression without observing that the Kamtschadales very thankfully acknowledge their obligations to the bears for what little advancement they have hitherto made either in the sciences or polite arts. They confess that they owe to them all their skill in physic and surgery; that by remarking with what herbs these animals rub the wounds they have received, and what they have recourse to when sick and languid, they have become acquainted with most of the simples in use among them, either in the way of internal medicine or external application."

After this we are not surprised when we are told that the Kamtschadales receive instruction from the bears even in the "polite arts," and imitate in their dances the various attitudes and gestures of these animals. It seems that in the rôles of master and pupil the proverbial Savoyard and dancing bear would find matters reversed in Kamtschatka.

Millbrook, Tuam, February 3

J. BIRMINGHAM

Electric Railways

PROF. AYRTON speaks as to the advantages obtainable from an electric system of railways. He says:—"The mass of the locomotive adds at least 50 per cent. to the horse-power absolutely necessary to propel the carriages along" (NATURE, vol. xxvii. p. 255). In short, he speaks of the weight of the ordinary locomotive as superfluous, and considers that "a far larger number of passengers may travel at a greater speed and with less fear of danger than at present." Now, speaking practically, it is difficult to conceive of a train of carriages running sixty miles per hour without any massive locomotive in front. It would be easy enough to get up the requisite speed, but the train would certainly leave the road, there being nothing tending to keep the carriages steady, unless they were very heavy. The grip on the rails is directly as the weight of rolling stock, and it is generally found that the light coaches leave the road more readily than the modern heavy carriages. Of course the cant of the rails must not be neglected. I wish that Prof. Ayrton would favour NATURE with a few remarks on these points.

The Channel Tunnel

WILL you allow me to correct an unfortunate slip of the pen in my article on "The Silver Streak and the Channel Tunnel" in the current number of the *Contemporary Review*? The rate of the progress of the French Channel Tunnel from the little village of Sangatte towards the English shores was, in November last, 18 yards per day and not "per week." At the present time the Beaumont and English boring machine is cutting the 7-foot driftway at the rate of more than 20 metres per day, and has not arrived at the limit of its capacity.

W. BOYD DAWKINS

Owens College, Manchester

The Great Comet of 1882

THE comet not having been visible to my naked eye during the last lunation, I was astonished to find last night that (doubtless owing to its increasing altitude; and the clear, dark sky) its tail is still so visible, quite distinctly, though very faint. I saw it best with a pair of field-glasses, aperture 2.05 inches, power 4; with which it reached to ν^2 Canis Majoris, and was therefore $5\frac{1}{2}^\circ$ long; unless part was really a wisp of the Milky Way: undoubtedly the greater part was the comet. Its axis (which was nearer the north than the south edge) was straight for $3\frac{1}{2}^\circ$, and then appeared to curve southwards somewhat. Its south edge was straight, but its north edge, which was more definite, was convex. Its width was nearly 2° . I could not detect any of the definite features which were so remarkable formerly.

The tail was nearly as long with the naked eye. Its head and two neighbouring stars were plainly visible to the naked eye as one star. One of these stars (Lalande 12,056) was decidedly brighter than the comet's head, which would be about of the 7th mag.

With a 4½-inch refractor the head continues elongated. With a power of 20, its major axis (which was in the direction of the tail) was 16' long, and its minor axis 11'. With a power of 38 it was 13' by 8½'.

THOS. WM. BACKHOUSE

Sunderland, January 31

Meteor of November 17

It is perhaps rather late to revert to the auroral cloud of November 17, but I am away from home, and have only now gained the requisite information. The path which I ventured to assign for it in your issue of November 30, from a digest of the printed reports, as compared with my own observations at Clevedon, proves to have been substantially correct. The cloud passed in the zenith at Brussels, as witnessed by M. Montigny, an eminent Belgian savant; and at Laon it was seen to the northward, as it were, gliding round the upper edge of the great main arch of the aurora. The actual elevation above the surface of the earth may therefore, without much risk of error, be considered as between forty and forty-five miles.

Montreux, February 3

STEPHEN H. SAXBY

The Sea Serpent

LIKE your correspondent, Mr. Sidebotham (in NATURE, vol. xxvii. p. 315), I have frequently seen a shoal of porpoises in Llandudno Bay, as well as in other places, and on the occasion referred to by Mr. Mott, in NATURE, vol. xxvii. p. 293, the idea of porpoises was at first started but immediately abandoned. I will venture to suggest that no one has seen a shoal of these creatures travel at the rate of from twenty-five to thirty miles an hour. I have seen whales in the ocean, and large flocks of sea-birds, such as those of the eider duck, skimming its surface; but the strange appearance seen at Llandudno on September 3 was not to be accounted for by porpoises, whales, birds, or breakers, an opinion which was shared by all present.

WILLIAM BARFOOT

Welford Place, Leicester, February 2

IN the summer of 1881 I was staying for some weeks at Veulettes, on the coast of Normandy. While there, on several occasions, several members of my party, as well as myself, saw, at a distance of three or four miles out at sea, what had the appearance of a huge serpent. Its length was many times that of the largest steamer that ever passed, and its velocity equally exceeded that of the swiftest. What seemed its head was lifted and lowered, and sometimes appeared to show signs of an open mouth. The general appearance of the monster was almost exactly similar to that of the figure in your correspondent's letter published on the 25th ult. Not the slightest appearance of discontinuity in its structure could be perceived by the eye, although it seemed incredible that any muscular mechanism could really drive such an enormous mass through the water with such a prodigious velocity. I carefully watched all that any of us caught sight of, and one day, just as one of these serpent forms was nearly opposite our hotel, it instantaneously turned through a right angle, but instead of going forward in the new direction of its length, proceeded with the same velocity broadside forward. With the same movement it resolved itself into a flock of birds.

We often saw the sea-serpent again without this resolution being effected, and, knowing what it was, could with difficulty still perceive that it was not a continuous body; thus having a new illustration of Herschel's remark, that it is easier to see what has been once discovered than to discover what is unknown. Possibly this experience may afford the solution of your correspondent's difficulty.

W. STEADMAN ALDIS

College of Physical Science, Newcastle-upon-Tyne, Feb. 3

Natural Enemies of Butterflies

It would be very interesting to ascertain what testimony can be brought forward to show that the Rhopalocera are commonly the prey of insect-eating birds. The return of a gentleman who has been collecting butterflies and studying their transformations